most gorgeously coloured, long-enduring sunsets, of the times of the conspicuous red glows' commencements; but this average interval appreciably surpassed the shorter space of 25–50m. (as did also the fading out duration of nearly an hour exceed that of only 20-25m.) observed in last month's displays; and the computed heights accordingly of the glow-producing matter ranged considerably lower (from 5 or 8 to 13 or 20 miles) in these latter than in the memorable sunset glows which followed the great eruption in Java on August 27, 1883, when heights appear to have been found of 13 or 17 to 25 or 30, or even possibly of 40 or 70 miles, for the strata of the atmosphere contaminated with volcanic dust.

The relative height results and the comparative intensities of the present and of the former glow displays seem, however, to have been in quite naturally comprehensible agreement with the lower height of projection, and with the generally lesser magnitude of the recent fearfully destructive outburst on the islands of Martinique and St. Vincent, when compared with the terrifically violent and immense volcanic explosion of Krakatoa in August, 1883, which is generally admitted to have had no previous parallel, in respect of scale and violence of mountain-mass ejection, in the history of such terrestrial convulsions. It will be interesting to notice on future nights if more examples of rose-red coloration should occur, when the times of the white and yellow sky-tracts becoming pink and ruddy should be noted, as the past month's rosy and fire-tinted sunsets were perhaps not quite sufficiently conspicuous to establish their certain connection with the terrible volcanic catastrophe of May 7-8 last in the West Indies. But considering the low temperature and continued cold soaking rainfall during all the early part of last month, until Sunday, June 22, it seems far from easy to conceive that the strikingly fine sunset display of Thursday, June 26, and the conspicuously rosy colorations of the sunset sky on June 27 and 28 can by any possibility have been merely sunset glares produced by ordinary floating dust raised locally from parched or arid tracts of land by the heat and fresh east wind of those few days of the first short interval of summer warmth and sunshine in last month, on which they were observed.

Observatory House, Slough, July 10. A. S. HERSCHEL.

P.S.—July 16.—A very fine display of orange-reddish streamers diverging in an open fan of six or seven stately light-beams from a similarly coloured horizon glow, 6° or 8° high at their common base where the sun had set (at about 8h. 15m.), was seen here on Monday evening, July 7. From 8h. 50–55m., when these fiery looking beams began to appear, up to altitudes of about 35°, across a rosy tract of sky which had sunk to the elevation of their growing crests from a higher region of pink colour first distinctly well perceived at 8h. 42–44m., their radiant light-sheaves shortened gradually without change of place or brightness; and they lasted thus quite 20m., retreating slowly into the decreasing glow at the horizon until that glow itself, at last, grew quite low and dull at 9h. 15m. The pink glow's lower border, when the first bands of streamers crossed it, was not more than 10° or 12° from the horizon, and the glow's red hue soon permeated all the yellow belt of sky which lay below it, while the streamers, at their heads, grew orange-red in place of pink, and thus from 8h. 50–55m. onwards, the whole display, until it subsided, was of one bright pinkish-orange tint in all its features. The new moon's very slender crescent, at 8h. 55m., lay less than 1° from the horizon, under the end part of the most southern streamer, looking pure yellow, and showed by its clear visibility how free from mist and smoky haze the sky was on that evening quite close to the horizon.

From the pink glow's first appearance at 8h. 43m. with an altitude of about 35°, at about 28m. after sunset, the resulting real height of the layer of dusty air which was thus lit up by the sun's departing rays, could not much exceed 5 miles above the earth's surface. On other dates in July before and since that notable appearance, the observed occurrences of a pink tinge in the sunset sky were scarcely noticeable, and the estimated time of its first appearance was only once thought to be pretty certainly trustworthy, on Sunday, July 13. A rosy tinge then first presented itself pretty brightly at 8h. 41m., about 33m. after sunset, at about altitude 40°, sinking down along the heads of some nearly vertical wide streamers, in three or four minutes to altitude 15°–20°, where it soon died away. The height of the mauve-coloured haze-stratum in the atmosphere which this observation pretty nearly indicated would seem to have been about 7 or 8 miles.

In addition to the above short notes of some particular accounts contained in NATURE of the bright sky-glows of November and December, 1883, it was observed, I find also, by Mr. E. Douglas Archibald, at Rusthall, near Tunbridge Wells (NATURE, vol. xxix. p. 176), that after sunset (at about 3h. 51m.) on December 6, a bright silky-looking white space in the clear sunset sky changed to pink at 4h. 25m. (34m. after) and to red at 4h. 45m. (54m. after sunset), which would imply heights of the pink and red glows of about 8 and 21 miles above the earth. But from the appearance of the glow on December 7 and of its reflection on low clouds, Mr. E. D. Archibald remarked that the red light's long continuance after the pink glow's departure was mainly attributable to cloud or haze reflections of true red coronal glares about the sun; and the conspicuous tinging of the white space with pink or rosy iridescence he concluded, from the interval between the concluding glow of ordinary cirrus and the commencing glow of the loftier dust stratum, corresponded more nearly with a height of from 10 to 13 miles, than with the great height of 40 miles assigned to the glow (probably from long-lasting reflection of red glows in the west on low-lying clouds, or perhaps even on the high dust stratum itself) by Prof. von Helmholtz.

Distribution of Pithophora.

IN your Notes of July 17 you state that Mr. Kumagusu Minakata wishes to know if any species of the genus Pithophora besides *P. Kewensis* has been reported from any part of the Old World except Japan since 1877.

P. radians, West and G. S. West, was described from Loanda, on the west coast of Africa, in *Journ. Bot.* (January, 1897, p. 36), and has more recently been found in Ceylon (cf. *Trans.* Linn. Soc., bot. ser. 2, vol. v., 1902, p. 132). *P. Reineckii*, Schmidle, was described from Samoa in Engler's *Bot. Jahrb.* (xviii., 1896). Schmidle has also described at least one other species from the Old World, but I have not the reference to hand. It will be found within the last five years either in Engler's *Bot. Jahrb.* or in "Hedwigia."

G. S. WEST.

Royal Agricultural College, Cirencester, July 18.

Saturn Visible through the Cassini Division.

IN NATURE of May 22 you were good enough to publish my prediction that, on July 17, the Cassini division of Saturn's ring would be invisible where it crossed the planet.

On July 15, Mr. Townshend, president of the Leeds Astronomical Society, reports that he saw the division throughout the ring and crossing the globe, but that on the 17th the portion crossing the globe was invisible. Mr. Townshend observed with a 10-inch reflector, and is a very competent observer.

On July 17 I was observing with a 9-inch refractor, and the Cassini division, clearly seen in the ansæ of the ring, was quite invisible in that part of the ring which crossed the globe.

I shall be very glad to receive notes of other observations of Saturn made on July 17, and shortly before and after that date.

Invermay, Leeds, July 21. C. T. WHITMELL.

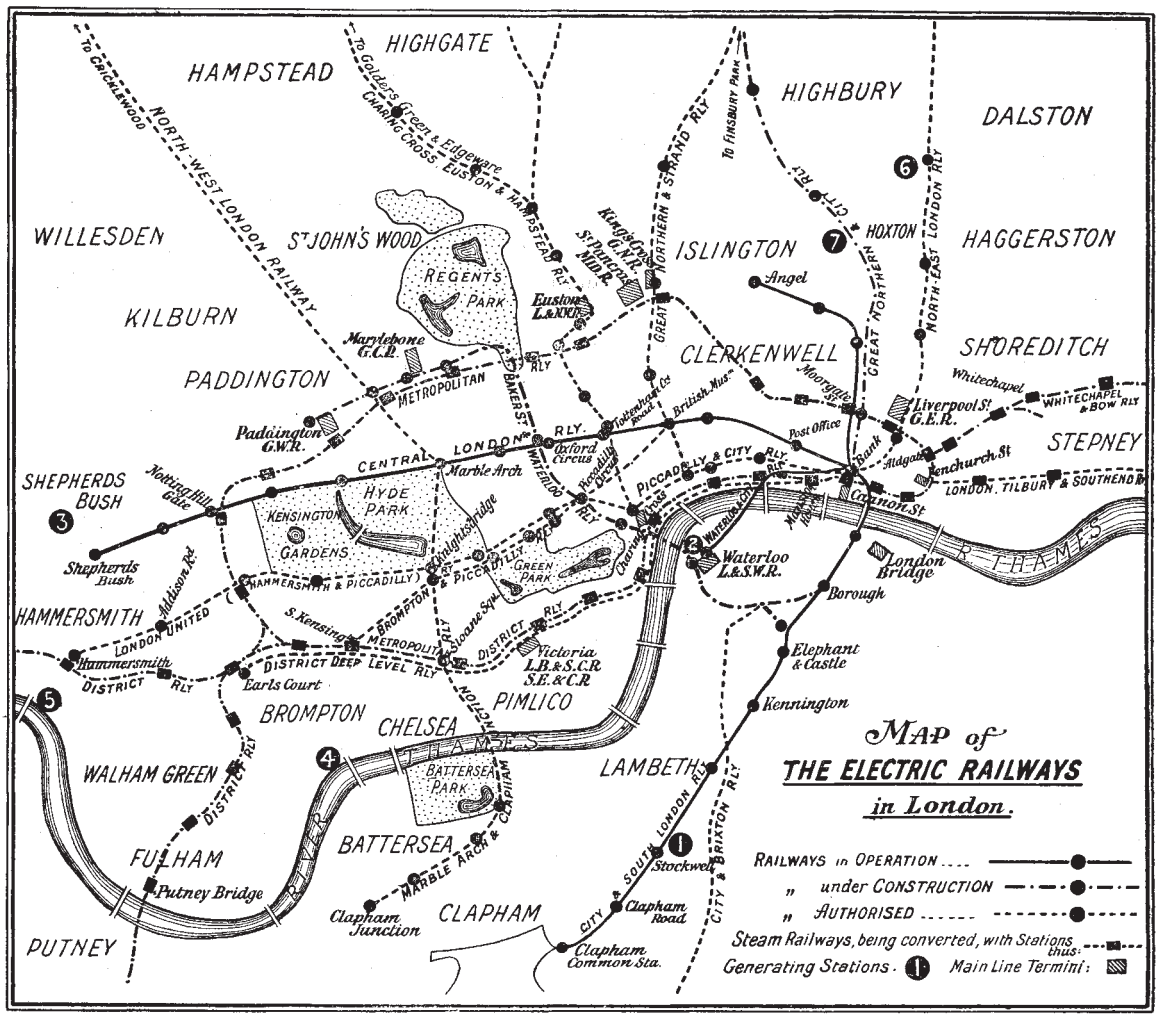
THE ELECTRIFICATION OF LONDON.

THE various electric railway Bills which have already passed through the House of Lords came up for second reading in the House of Commons last week. In spite of some attempts to reject several of these Bills they all successfully passed the second reading and have been referred to two Select Committees of the House of Commons. These Committees, each of which will deal with about half-a-dozen Bills, are to hold their first meetings at once, the one under the chairmanship of Sir L. M'Iver, the chairman of the other being Mr. Seale-Hayne.

The Bills have already been thoroughly investigated by the Select Committees of the House of Lords presided over by Lord Windsor and Lord Ribblesdale during April and May. These two Committees had much the more arduous task, as they had to deal with a larger number of Bills, several of which they rejected. It is possible, as a result of their work, to form some idea of

the probable effect of the proposed new railways in relieving the congested London traffic. It will be understood that it is assumed in the following article that the Bills which have passed the House of Lords will also pass through the Commons without any modifications of the first importance. In all, no less than twenty-four different Bills have come before Parliament this session relating to electric railways in London; of these eighteen were for new railways or extensions of authorised routes, one was for power to run an existing steam railway electrically, and the remaining five for extension of time for construction. The extension of time was in all cases granted, but it seems that the number of instances in which it was applied for had a notable effect on the decisions of the Committees with regard to other schemes. For it was the difficulty in raising the necessary capital which made application for extension of time necessary, and, as a result, where new railways were promoted the Committees required evidence that the promotion was financially well backed before sanctioning the lines. Of the eighteen Bills for new railways, many were directly in competition for the same route, so that it was inevitable that some should be rejected. Thus there were three different companies promoting Bills for a railway connecting Hammersmith with the city, one of these being the Central London Railway, which proposed to run the new line as a "circle" in conjunction with their existing route. This Bill was, however, rejected, the successful competitor being the London United Railways, which, working with the London United Tramways and the Piccadilly and City and North-East London Railways, will provide a through route from the extreme west to the north-east of London.

From the map which we publish in illustration of this article, the references to different railways will be easily understood. For the data for this map we are largely indebted to the excellent maps published from time to time in the *Electrician*. It shows only those lines the construction of which has been authorised (or which are in operation), and a different system of drawing has been adopted to indicate which railways are working, which under construction and which merely authorised. The engineering details, so far as they are yet decided, show a remarkable uniformity, resulting partly from the decisions of the Board of Trade, the Vibration Committee, &c., which have recently been given in connection with different difficulties arising in the construction and working of "tube" railways. Most of the new railways will be "tubes." The Hampstead-Edgware line, which is to be about 6 miles long, is to run in the open; it forms a continuation of the Charing Cross, Euston and Hampstead Railway shown on the map; so also will a few miles of



the northern end of the North-East London Railway which runs past Tottenham to Palmer's Green. Of course, also the Metropolitan and District Railways and the London, Tilbury and Southend Railway (which is authorised to convert to electric traction) will not run in tubes. In some of the railways the proposed diameter of the tube is 11 feet 6 inches, and in the others two feet larger than this, Mr. Yerkes favouring the smaller diameter for the railways under his control. The larger diameter allows of the construction of two platforms, one on either side of the train, for the use of passengers in case of an accident. These, with the electric lighting of the tunnel which it is proposed to carry out, will afford an easy means of getting to the nearest station should a train be stopped in the tube. With the smaller tubes it will not be possible to have these platforms, and passengers will have to use the permanent way as a means of escape. The smaller tunnels will also involve slightly raising the floor level of the motor carriages to allow room for the motor equipment, which will involve possibly slight inconvenience to passengers. Against these disadvantages must be set the diminished cost of construction. It is also claimed by Mr. Yerkes that the side platforms are really more dangerous than a platform along the permanent way, and would, moreover, be destroyed in case of a derailment.

The electrical details of all the schemes are very similar. Current will be generated as high-pressure alternating current, and transformed to continuous current at 500 volts for working the trains. The multiple-unit system has been adopted—that is to say, the trains will consist of two or three motor cars with three or four trailers, and will not be entirely of trailer cars drawn by a single locomotive. It is also noteworthy that both the conductors are to be insulated, the rails not being used as a return; in the case of the tubes of larger diameter, both conductors will be underneath and protected by one of the side platforms, whereas with the smaller tubes, one conductor, the positive, will be at the side of the track and adequately shielded and the return negative conductor will be between the rails.

The District Railway, including the deep-level line from Earl's Court to the Mansion House, the Brompton and Piccadilly, the Great Northern and Strand, and the Charing Cross, Euston and Hampstead Railways, all of which are under the control of Mr. Yerkes, are to be supplied with power from a generating station by the riverside at Chelsea (4). The generating pressure is to be 11,000 volts and the output 50,000 kw., the station being the largest for traction purposes in the world. The railways under Mr. Morgan's control are the Piccadilly and City, and the North-East London. These, with the two railways belonging to the London United Railways, viz. the Hammersmith and Piccadilly and the Marble Arch and Clapham Junction, in the former of which Mr. Morgan owns a half share, will be supplied with power from two generating stations, one in Fulham (5) having a capacity of 12,000 kw., and the other in the Kingsland Road (6) having a capacity also of 12,000 kw.; it is proposed to use three-phase transmission at 10,000 volts.

It will be seen from the map that although, on the whole, London will be very well supplied with rapid transit facilities when all the new railways are working, there are still some districts inadequately catered for. It must, however, be remembered that in many of these districts there are good tramways either running, or to be run, electrically. Thus, in the south-east corner of the map, the network of tramways is fairly comprehensive. In the north-west the Middlesex county light railways will help to bring traffic to the city. A tube railway for the north-east, connecting Waltham Abbey and Walthamstow with the city, was withdrawn owing to certain alterations in the city end of the route, but it is understood that a similar line will be promoted next session. Indeed, one cannot help feeling that there are for the present a sufficient number of railways in hand, especially when it is considered how many are being financed by the same people; it will be time enough when these are either running or well advanced in construction to promote other Bills for the more complete electrification of London.

The question of fares and through booking is likely to become of importance when all the railways are at work. At present opinion seems divided between the system of the Central London Railway and the more usual booking system. It would certainly seem 'that when the whole network is complete a through booking arrangement would be a great convenience to the travelling public. At present, whilst the railways are few and the number of cross connections still fewer, the matter is not one of much importance; but once it becomes possible to travel from almost any part of London to any other by electric railway, the journey necessitating possibly two or three changes of line by the way, the question is put on another level. This is, however, a consideration which may well be left for time and circumstances to settle.

We may conclude by a brief summary of the route and principal points of interest of the different lines.

(1) *City and South London Railway.*—This, the first electric railway in London, was opened in 1890. It has since been extended, and now runs from Clapham Common through the City to Islington. The original electrical equipment of the power station was replaced in 1900; the line is remarkable, as it is run on a three-wire system. The power station is at Stockwell (1), and has a capacity of 3000 kw. The train voltage is 500, and the rails are used as return conductors. Length of line 6¼ miles, and scheduled speed 15 miles an hour. The trains are drawn by locomotives.

(2) *Waterloo and City Railway.*—This railway was opened in 1898 to connect the L. and S.W.R. with the City. It has no stations beyond those at Waterloo and the Bank. Length of line 3 miles, speed 18 miles an hour. Multiple unit system used, 500 volts pressure, and rails as return conductors. Generating station at Waterloo (2), capacity 1300 kw.

(3) *Central London Railway.*—The railway was opened in 1900, and runs from Shepherd's Bush to the Bank. The western end is fed by the London United Tramways coming from Hounslow and Southall. The length of line is 6 miles and the speed 14½ miles an hour. Locomotives were originally used, but experiments with the multiple unit system have recently been tried on account of the vibration troubles, and the Company has just closed a contract with the British Thomson Houston Co. for 64 motor-car and 160 trailer-car equipments. The rails are used as return conductors. Power is generated at Shepherd's Bush (3) at 5000 volts; capacity of station 5100 kw.

(4) *Metropolitan and District Railways.*—The lines to be electrically equipped include the Inner Circle and the Hammersmith and Putney branches. They afford a means of approach to the City from the south-west, and also communication through various districts by means of the "Circle." The electrification will be completed in eighteen months or two years.

(5) *District Deep Level.*—This is to provide an express route from Earl's Court to the Mansion House running under the existing line. The line is authorised, but construction work is not yet begun.

(6) *Whitechapel and Bow Railway.*—This branch of the District Railways will be electrified with the rest; it affords connection with the London, Tilbury and Southend Railway at Bow.

(7) *Brompton and Piccadilly Railway.*—The line will run from South Kensington Station (District Railway) *viâ* Knightsbridge to Piccadilly Circus; the construction

work has just started. An extension to Holborn has been granted, where (besides connecting with the Central London Railway) it will form a junction with the

(8) *Great Northern and Strand Railway.*—This will run from Finsbury Park (G.N.R.) past King's Cross and Holborn to the Strand.

(9) *Charing Cross, Euston and Hampstead Railway.*—Starting at the Charing Cross end, the line runs to Tottenham Court Road, where it gives a cross connection with the Central London, thence *viâ* Euston to Hampstead (Golder's Green) and Highgate. At the Golder's Green end there is to be a junction with the

(10) *Hampstead and Edgware Railway.*—This is to run in the open to Edgware. The line, which is outside the limits of the map, is to be controlled by the Charing Cross, Euston and Hampstead Railway.

(11) *Baker Street and Waterloo Railway.*—This railway was authorised in 1893. Construction work is now considerably advanced. The line with the extensions granted runs from Paddington (G.W.R.) *viâ* Marylebone (G.C.R.), Baker Street, Oxford Circus, Piccadilly Circus, Charing Cross and Waterloo to the Elephant and Castle, where it connects with the City and South London Railway.

Mr. Yerkes holds a large interest in all the above railways (4–11). Power will be supplied to all (except possibly the two last) from the generating station in Lots Road, Chelsea (4), particulars of which have already been given. The Metropolitan Railway has, however, a separate power station at Neasden.

(12) *London United Railways (Hammersmith and Piccadilly).*—This line, which is promoted by the London United Tramways and half owned by Mr. Morgan, will run under Hammersmith Road, Kensington High Street and Piccadilly to the Circus. At the Hammersmith end it is fed by the tramways. At the Piccadilly end it forms an end-on junction with the

(13) *Piccadilly and City Railway.*—This line is to run from Piccadilly Circus to Charing Cross, and thence under the Strand and Fleet Street to the Bank. At the Bank there is an end-on junction with the

(14) *North-East London Railway.*—This railway runs from the Bank through Highbury and Tottenham to Palmer's Green (near Southgate). The last few miles are to run in the open. This, with the two above lines and the London United Tramways, will give a through route from the extreme west to the north-east of London. Through booking is to be adopted, the proposed fares being extremely small. The group is known as the "Morgan" group, and will be supplied with power from the stations at Fulham (5) and Kingsland (6).

(15) *London United Railways (Marble Arch and Clapham Junction).*—This line gives a south and north connection running from Clapham Junction *viâ* Sloane Street under Hyde Park to Marble Arch. It is promoted by the London United Tramways Company, and will obtain power from the same station as their other railway. At Marble Arch there is connection with the Central London Railway and an end-on junction with the

(16) *North-West London Railway.*—This railway is to run under the Edgware Road to Cricklewood. The line was authorised in 1899, but construction work has not yet started. There are to be stations every half mile.

(17) *Great Northern and City Railway.*—An extension of this railway (which starts at Finsbury Park) to the Bank has been granted. The construction work is nearly completed. The generating station is to be on the Regent's Canal (7).

(18) *City and Brixton Railway.*—This line, which has been leased to the City and South London Railway, runs under the Brixton Road and connects Brixton with the City. Construction work has not yet commenced and details are not available.

(19) *London, Tilbury and Southend Railway.*—Powers have been granted to run the whole of this line electrically, but it is not proposed to do so until necessary. At first only such portions will be converted as are considered necessary to work in with the District Railway electrification. A site, large enough for a generating station for the whole line, has been acquired on the River Roding (a little beyond the limit of the map).

M. S.

THE PITTSBURG MEETING OF THE AMERICAN ASSOCIATION.

THE fifty-first annual meeting of the American Association for the Advancement of Science was held at Pittsburg, Pa., June 28–July 3, 1902, under the presidency of Prof. Asaph Hall, formerly of the United States Naval Observatory, and Harvard University.

The meeting was not a large one, but was attended by many of the leading men of science in the United States. The total registration was 436, and the majority of those in attendance were Fellows. A number of affiliated societies met at the same time and place in connection with the Association. These societies were the Geological Society of America, the American Chemical Society, the Society for the Promotion of Agricultural Science, the Botanical Society of America, the American Microscopical Society, the American Folk-Lore Society, the Association of Economic Entomologists, the Society for the Promotion of Engineering Education, the American Physical Society, the American Anthropological Association and the National Geographic Society. The meetings of these societies were all largely attended and their registration was not included in that of the Association, so that the Pittsburg meeting was practically a gathering of about one thousand scientific men.

As is quite natural, on account of its great mining and manufacturing interests, Pittsburg proved to be an especially attractive meeting-place for the engineers and geologists. The botanical and chemical sections and their affiliated societies were also represented with especial strength.

The address of the retiring president, Dr. Charles Sedgwick Minot, of the Harvard Medical School, was delivered on the evening of July 1 and is printed in full in this number. The other evening functions of the meeting were :—(1) A popular lecture by Dr. Leonard P. Kinnicutt, of the Worcester Polytechnic Institute, on "The Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment." Dr. Kinnicutt is a well-known American expert in this line of work, and has been a careful observer of the experiments which have been and are being made in England, many of his lantern slides referring to English work. (2) On July 3 Mr. Robert T. Hill, of the U.S. Geological Survey, gave an illustrated lecture on the recent volcanic eruptions in Martinique. Mr. Hill was leader of an expedition to Martinique a few days after the eruption of Mont Pelée, other members being Prof. I. C. Russell, of Ann Arbor, Mich., and Commander Borchgrevink. The expedition was sent out by the National Geographic Society.

The vice-presidential addresses were as follows :—

Prof. James McMahon, of Cornell University, before the Section of Mathematics and Astronomy, on the subject "Some Recent Applications of the Function Theory to Physical Problems." Prof. D. B. Brace, of the University of Nebraska, before the Section of Physics, on the subject "The Group Velocity and the Wave Velocity of Light." Prof. H. S. Jacoby, of Cornell University, before the Section of Mechanical Science and Engineering, on the subject "Recent Progress in American Bridge Construction." Dr. B. T. Galloway, of the U.S. Department of Agriculture, before the Section of Botany, on